Assessing the Cost of Redesigning Developmental Mathematics

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The number of students needing remediation upon enrollment in post-secondary institutions has risen steadily in recent years. Concurrently, state legislatures and governing boards are putting pressure on higher education institutions to lower budgets. Under these conditions, developmental education programs are often primary budget- tightening targets. In response to this scrutiny, administrators and faculty members at Middle Tennessee State University created a structure that included special sections of two general education mathematics courses. This new design resulted in cost savings for the university and cost and time savings for students. The redesigned curriculum at MTSU has strong implications for post-secondary institutions that find it necessary to reduce expenditures while continuing to serve students who are lacking skills that would prepare them for success in entry-level mathematics courses.

As the number of students enrolling in higher education increases steadily (National Center for Education Statistics [NCES], 2008), the number needing remediation has risen to approximately one-third of all first-year students (Boser & Burd, 2009). The growing need to accommodate high-school graduates who are underprepared for college-level classes has evoked the scrutiny of governmental agencies, institutions of higher education, and the public (Perkhounkova, Noble, & Sawyer, 2005). This has resulted in a debate over the actual cost of educating underprepared students at the collegiate level which has produced no conclusive results to date. Citing various reasons for limitations in the collection of reliable data related to this issue, Saxon & Boylan (2001) concluded

that most studies show remedial or developmental education costs to range from 1% to 2% of educational costs on the whole. Other estimates were higher. In a report on the cost for the state of Michigan, Greene (2000) extrapolated the costs to the national level and estimated an expenditure, including lost productivity and other factors, of over $16 billion. As public demands for accountability increase, state legislatures and governing boards of higher education often look to lower or eliminate expenditures including reducing or eliminating budgets for developmental education (Shields, 2005).

In response to the focused examination of developmental education programs statewide, administrators and faculty members at Middle Tennessee State University (MTSU), a public four-year institution, formulated a structure for special sections of two of its general education mathematics courses. These K-sections accommodate the needs of students admitted to the University with ACT Mathematics sub-scores of 17 or 18. Students with these sub-scores were formerly tracked to a developmental studies program (DSP) to take Intermediate Algebra for institutional credit only. Following successful completion of Intermediate Algebra, students in the former design were required to complete another course to satisfy general education credits for mathematics. In the new structure, K-sections of College Algebra and Mathematics for General Studies were created to replace the DSP pattern. Additional topics were added to the curriculum of each course to address deficits in students' algebra skills. Other modifications undertaken included an increase in contact time and the incorporation of an online lab component. Following established guidelines for developmental mathematics courses, the student-teacher ratio remained constant at 25 students per section for the newly designed K-sections (Lucas & McCormick, 2007). The new design was piloted in fall 2006. Data from the new design and the old DSP design were studied to assess differences in cost between the two models. The study considered whether the new design would result in cost savings for the university and also examined the impact on student costs.

Costs to the University

Former DSP Design

Instructional costs for the DSP design are presented in Table 1. The dollar amounts listed for tenured faculty members reflect an average salary of $50,000 plus 27% for benefits, producing a total of $63,500 per year or $31,750 per semester. In the DSP design, tenured faculty taught four sections weighted at three workload hours each per semester. According to university policy ("Guidelines for Determining," 2008), twelve credit-hours (80%) of the semester workload are generated from instruction with an additional three credit-hours (20%) given to research, advising, and service activities. This distribution of faculty workload between instruction and other professional activities yields $6,350 per course.

Table 1: Temporary

Former DSP Design--Faculty Instructional Costs per Hour

	Tenured	Temporary
Salary per semester	$31,750	$22,225
Salary devoted to instruction	$25,400[a]	$22,225[b]
Instructional salary per course	$6,350	$4,445
Contact hours per course	45	45
Out of class hours per course	105	105
Total hours per course	150	150
Cost per hour	$42	$30

[a]Tenured faculty members have 80% of salary devoted to instruction.

[b]Temporary faculty members have 100% of salary devoted to instruction.

Consistent with university policy, one credit hour is equated to 50 clock hours. Using 150 clock hours per three credit-hour course, 45 hours were designated as contact hours with the remaining 105 hours classified as out-of-class hours. The instructional cost per course divided by the clock hours devoted to the course produces an instructional cost per hour of $42. Full-time temporary faculty also taught in the DSP model. For these faculty the average salary

was $35,000 plus 27% for benefits for a total of $44,450 per year or $22,225 per semester. Full-time temporary faculty members taught five sections per semester for a 15-hour instructional workload. One hundred percent of the time, and therefore salary, was devoted to instruction of five courses by part-time, temporary faculty. This resulted in a total cost of $4,445 per course. The division of contact hours and out-of- class hours was the same for tenured and temporary faculty. Using an equivalent number of clock hours per course generated $30 per hour instructional cost for temporary faculty. Tenured faculty teaching 27 sections generated 4,050 work hours. At $42 per hour, the total cost was $170,100. Temporary faculty teaching 14 sections generated 2,100 hours of work. At $30 per hour, the total cost was $63,000. Adding instructional costs for tenured and temporary faculty gave a grand total of $233,100. Dividing this total by 1,027, the number served in the period under consideration, students yielded an instructional cost of $227 per student for the DSP model.

New Course Design

Table 2 presents the instructional costs for the new course design. In the new model, additional contact time and a laboratory component are included (Lucas & McCormick, 2007). These supplementary features resulted in four hours of workload per K-section. In the new course design, tenured faculty taught three K-sections per semester yielding the same 12-hour workload. This resulted in no change in faculty instructional costs per hour. However, full-time temporary faculty members taught four K-sections per semester to produce a 16-hour workload. The extra workload hour, beyond the required 15, was compensated using the adjunct pay rate that averaged $625 per credit hour. Adding this amount to the average salary, $17,500, plus 27% for benefits, resulted in a total of $23,019 per semester per part-time faculty member.

In the DSP design, there were 150 clock hours allotted to each course. In the new design, each course carried a four-hour workload that by university policy equates to 200 clock hours. The same number of sections with the 25 student ceiling were offered in both models. As a result, the same number of sections was used

Table 2

New Design--Faculty Instructional Costs per Hour

	Tenured	Temporary
Salary per semester	$31,750	$23,019
Salary devoted to instruction	$25,400[a]	$23,019[b]
Instructional salary per course	$8,467	$5,755
Contact hours per course	75	75
Out of class hours per course	125	125
Total hours per course	200	200
Cost per hour	$42	$29

[a]Tenured faculty members have 80% of salary devoted to instruction.

[b]Temporary faculty members have 100% of salary devoted to instruction.

to calculate the instructional costs for tenured and temporary faculty. Tenured faculty teaching 27 sections completed 5,400 hours of work. At $42 per hour, the total cost was $226,800. Temporary faculty teaching 14 sections resulted in 2,800 hours of work. At $29 per hour, the total cost was $81,200. Adding instructional costs for tenured and temporary faculty gave a grand total of $308,000. Dividing by 1,027 students produced an instructional cost of $300 per student for the new design.

Costs to Students

The investigation of the special course offerings at MTSU considered the impact on students' expenditures in addition to chronicling institutional cost. Table 3 displays the student fee structure for the DSP design. It reflects state policy that required public universities to charge community college rates for developmental courses (Tennessee Board of Regents [TBR], 2001). In the first semester, students paid the community college rate of $285 to register for DSP courses while the university absorbed the difference ($348 per three-credit hour course). Successful completion of Intermediate Algebra was defined as earning a grade of C or better. Students who met this criterion in the first semester then enrolled in curricular mathematics courses to

satisfy general education mathematics requirements paying $633 in tuition. Students repeating the DSP course in the second and/or third semesters continued to pay the $285 community college rate. Over the three-semester period, the total cost absorbed by the university for students enrolled in the DSP course was $878,004. Table 3 shows the number of students who advanced from the DSP courses in the second semester and those who repeated DSP math. Thirty-five percent of students failed to pass DSP mathematics in the first semester and had to repeat the course. The number of students who advanced to curricular mathematics but then had to repeat it in the third semester was 43% (Lucas & McCormick, 2007). Students completing DSP mathematics were awarded three hours of institutional credit, and students completing curricular mathematics were awarded three hours of general education mathematics credit.

Table 3

Former DSP Design--Student Fee Structure

Semester	Course	Students	Cost[a]	Total
1st	DSPM 0850	1,713	$285	$488,205
2nd	MATH 1010/1710	1,113	$633	$704,529
	DSPM 0850 repeaters	600	$285	$171,000
3rd	MATH 1010/1710 (passed DSPM 0850 2nd semester)	390	$633	$246,870
	MATH 1010/1710 repeaters	479	$633	$303,207
	DSPM 0850 repeaters	210	$285	$59,850
TOTAL				$1,973,661

[a]Students taking DSP courses at the university were charged the community college rate of $285.

In the new design, students with ACT mathematics subscores of 17 or 18 are placed directly into K-sections without completing DSP mathematics. Students are charged $633 per course for these credit-bearing general education classes. Table 4 shows the revenues generated in the form of student tuition for the initial semester of the redesign and for students repeating in the two subsequent semesters.

Table 4

New Design--Student Fee Structure

Semester	Course	Students	Cost	Total
1st	MATH 1010K/1710K	1,713	$633	$1,084,329
2nd	Repeaters	564	$633	$357,012
3rd	Repeaters	186	$633	$117,738
TOTAL				$1,559,079

Findings

Careful examination of the costs associated with redesigning the mathematics curriculum for underprepared students showed savings for students and for the university. In the new course design, students received needed remediation and completed their general education mathematics requirement in one semester at a total instructional cost per student of $300. While this amount appeared to be an increase over the former model, the redesign eliminated one semester of mathematics course requirements for each student. In the DSP program, students had to complete DSP mathematics prior to enrolling in a general education mathematics course. The DSP model translated to $227 of instructional cost per student plus the additional instructional cost for the subsequent general education mathematics course resulting in an instructional cost total of $454 per student. The instructional cost in the new design is significantly less. With the elimination of one course, the instructional cost to the university was reduced by $154 per student or $263,802 for 1,713 students. The university experienced a further cost savings of $878,004 because it no longer had to absorb the difference between university student tuition rate and the community college tuition rate for DSP courses. With the new design, the university realized a total savings of $ 1,141,806.

Student fees associated with the former design generated $719,055 for DSP courses with institutional credit only. Over a

three-semester period in the DSP design, the student fee structure totaled $1,973,661, while the student fee structure for a similar period in the redesign totaled $1,559,079. In the redesign, students spent $414,582 less in tuition fees and received general education mathematics credit. As a result of the DSP mathematics course being eliminated, students realized textbook savings of $171,300 (1,713 students at $100 per textbook). With the new model, overall student savings amounted to $585,882.

In addition to monetary savings, the new design eliminated one semester of student coursework. Many researchers have noted that the extra time students are required to devote to developmental education is a deterrent to actual degree completion. Seventy-one percent of post-secondary students eventually earn a college degree if they have fulfilled their college-mathematics requirements by the end of their sophomore year (Adelman, 2006). In light of this research, reducing students' coursework by one semester may have a positive effect on graduation rates of underprepared students.

Conclusion

In view of the number of students needing remediation in post-secondary education and given the limited availability of fiscal resources, the redesign model piloted at Middle Tennessee State University has strong implications. While the nation seeks to increase the number of citizens with higher-education degrees, post-secondary institutions are finding it necessary to reduce expenditures as they continue to serve an underprepared student population lacking the skills for success in entry-level mathematics courses. The MTSU model equips students with relevant skills while providing a cost benefit to the state, to the university, and to the student. It is crucial to point out that eliminating a course merely to reduce the developmental education budget can be easily accomplished. However, the goal should be to restructure in a manner that not only lowers costs, but also provides the needed remediation of skills and the timely completion of general education mathematics. The ultimate goal is to better position students for success in achieving collegiate and career aspirations at a lower cost.

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